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Northern Region

Forest Pest
Management

BARK BEETLE CONDITIONS NORTHERN REGION 1993

Ken Gibson & Bob Oakes

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Northern Region
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United States Department of Agriculture

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Missoula, Montana

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BARK BEETLE CONDITIONS
Northern Region, 1993

Ken Gibson and Bob Oakes

INTRODUCTION

Most bark beetle species continued the decline observed and reported in 1992 (Gibson and Oakes 1993). For that reason, and because of a major reorganization of the Pest Management staff in the Region, this may be the last of the annual "Bark Beetle Conditions" reports, begun in 1978 (McGregor, et al, 1979). In June, 1994, several personnel presently assigned to the Missoula Field Office will be re-assigned to the Coeur d'Alene Field Office. With accompanying new assignments and priorities, less bark beetle-related work will be done from the Missoula Field Office, and perhaps in the Region as a whole. We are confident this reorganization will result in our overall Regional program of work being done more efficiently and effectively. Still, changing emphasis will necessarily and appropriately mean work formerly required to do bark beetle analyses will evaluate other pests, collect different data, or provide assistance in other areas of endeavor.

That should not be construed to mean that bark beetles, as a management concern, have become less important. They will almost certainly remain our most important, and potentially devastating insect pest. This present "lull" in their populations, however, will allow other much-needed work to be done. As forest stands mature, become overstocked, or develop environmental stress of one type or another, the likelihood of beetle outbreaks will increase. Inevitably, from time to time and from place to place, bark beetles will become epidemic--threatening timber values and other valuable resource commodities.

In the introduction to last year's report, we discussed the general philosophy of bark beetle surveys--both aerial and ground (Gibson and Oakes 1993). We needn't repeat that here. We do, however, point out once again that some inaccuracies are inherent in any survey. For that reason, caution must be exercised in extrapolating the data contained in this report to areas for which data were not collected. Areas of infestation mapped during annual aerial surveys are accurate for location and acres affected. The larger the infestation, however, the less reliable mortality estimates become. Ground surveys, on the other hand, are accurate for the area from which data is collected; but become less so for larger, less well-sampled areas. While those data should not be unreasonably applied to other infested areas, they can serve as indicators of infestation potential in stands of like conditions.

CONDITIONS IN BRIEF

Most bark beetle pests in the Region continued a gradual decline in 1993. Notable exceptions were mountain pine beetle populations in ponderosa pine, which showed significant increases in both northern Idaho and western Montana; western pine beetle outbreaks, up markedly in northern Idaho; and western balsam bark beetle, which remained at about the same high level of infestation on the Gallatin and Beaverhead National Forests (NF). The number of acres of subalpine fir infested by western balsam bark beetle was nearly twice that of lodgepole pine infested by mountain pine beetle–the first time in almost a quarter-century that mountain pine beetle in lodgepole pine was not the most expansive bark beetle pest in the Northern Region. (Mountain pine beetle still holds the edge in trees killed, however. More than three beetle-killed lodgepole pines were recorded for every beetle-killed subalpine fir.)

In addition to a somewhat general decline--in both scope and intensity--of most insect pests this year, their behavior was somewhat erratic. Mating flights were postponed, prolonged, or in some cases, nearly nonexistent. That was true for bark beetles as well. Whether a result of the abnormally cool and wet spring, or the milder-than-normal winter last year, we're not sure. Whatever the reason, it was an unusual year for insect

behavior. In addition to typical field activities, we conducted three major technology development projects--attempting to use bark beetle pheromones to manipulate beetle populations to our advantage. In two of the projects, atypical beetle flights made interpretation of results difficult or impossible. In the third, results were at least influenced by weather.

Figure 1 illustrates infestation trends of the major bark beetle species during the past 15 years (1979-1993). Vertical scale is in thousands of acres. We point out that mountain pine beetle infested acres, at their peak (1981), were more than 23 times the acres infested by any other bark beetle species at its peak (fir engraver in 1989).

Mountain Pine Beetle (MPB)

Though infested area continued to decline, MPB remains the most important, and potentially destructive, insect pest. In 1993, beetle-impacted acres (all hosts, all ownerships) totalled just over 51,000 (Tables 1 and 2). That is the lowest figure reported since almost 50,000 acres were recorded in 1970--and a mere 2 percent of the peak of nearly 2.5 million acres infested in 1981. Of the 1993 total, approximately 7,700 acres were recorded in northern Idaho. The remaining 43,300 acres were, for the most part in western Montana (Figure 2). Comparable acreage figures for 1992 were 79,600 total, with 13,500 in North Idaho and 66,100 in Montana (Tables 1 and 2). That included, however, a perhaps erroneously high figure for acres of beetle-killed western white pine.

Declines in acres infested were noted in most reporting areas, and in most affected hosts. Exceptions were in ponderosa pine stands on the Mica Fire Protection District (FPD), west of Coeur d'Alene Lake, and on the Nez Perce NF in central Idaho. In western Montana, increases were noted on the Flathead Indian Reservation (IR) and Flathead and Lolo NFs. In total, Region-wide, infested ponderosa pine stands nearly tripled--from 5,500 acres in 1992 to 14,400 acres in 1993.

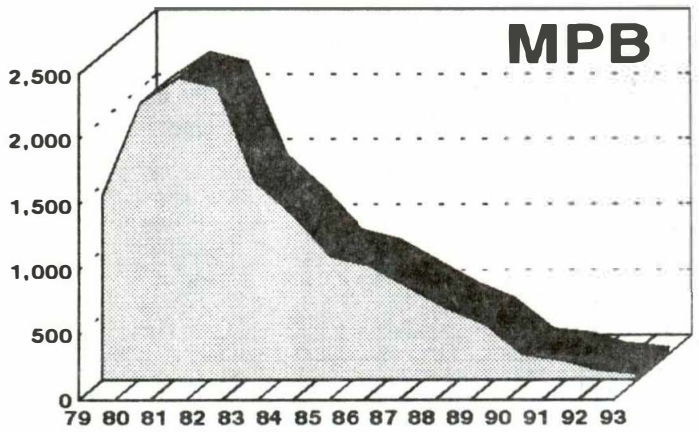
Lodgepole pine stands infested by the beetle increased slightly in northern Idaho, most significantly on the Idaho Panhandle NF (IPNF) near Bonners Ferry, and in the Craig Mountains south of Lewiston. That was more than offset, however, by the major decline in lodgepole pine stands affected in western Montana. Serious outbreaks still exist on the Plains/Thompson Falls and Superior Ranger Districts (RD), Lolo NF, and on the Swan Lake RD, Flathead NF; but almost everywhere else reductions in infested area occurred. Total infested lodgepole pine acreage was reduced from 57,600 to just over 29,100 acres.

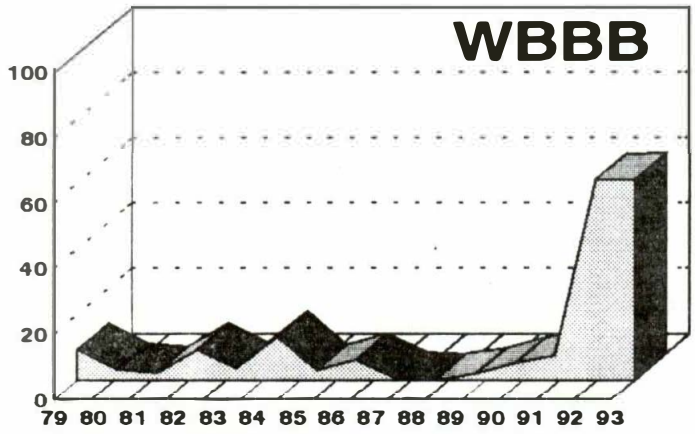
Western white pine stands in both Idaho and Montana continued to experience serious losses from a combination of winter damage, blister rust and mountain pine beetle. Throughout the Region, an estimated 2,700 acres were infested to some extent--of which 2,000 were in Montana. That figure was down markedly from the 12,500 acres recorded in 1992. Nearly 9,000 of those 1992 acres were mapped in northern Idaho, an area where blister rust-caused mortality is high. We now believe much of the mortality attributed to MPB in 1992, on the IPNF, was caused by blister rust, though there is no doubt a relationship between the two pests.

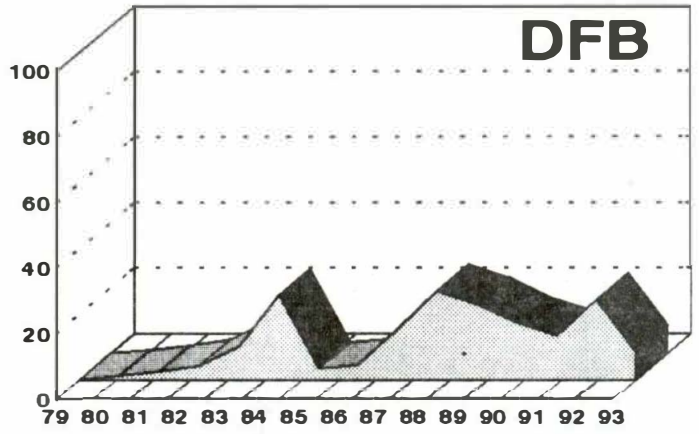
Some sustained mortality was also noted in a few high-elevation whitebark pine stands in both States. Those infestations were generally light and scattered. In total, mountain pine beetle populations accounted for an estimated 16,600 trees killed in Idaho (2.2 per acre) and another 112,100 in Montana (2.6 per acre).

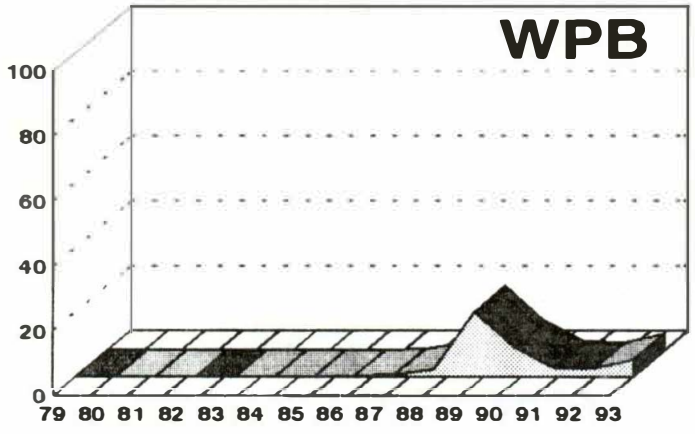
Though beetle populations are currently low, much susceptible lodgepole pine remains in the Region. So long as suitable hosts are available, the threat of increasing mountain pine beetle depredations will exist. In the short-term, however, we can anticipate a declining trend to continue for the next few years.

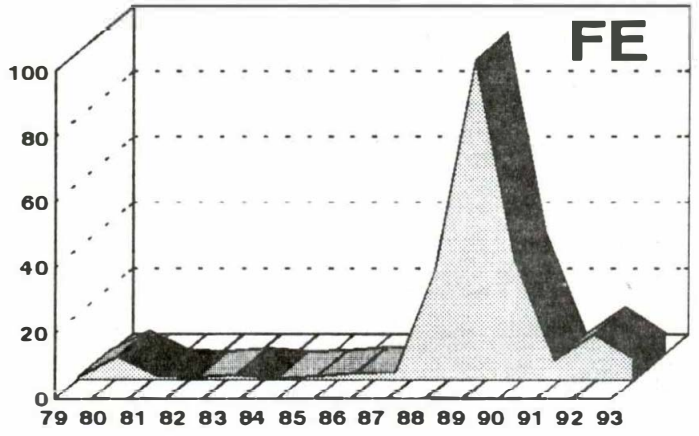
Figure 1.--Bark beetle infestation trends, Northern Region, 1979-1993. (Thousands of infested acres.)

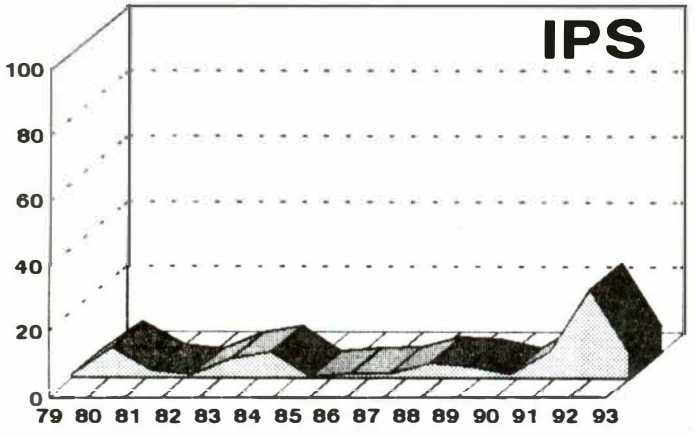












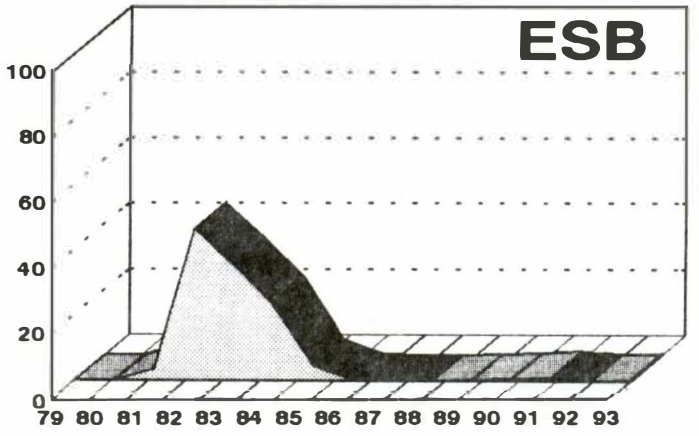


Table 1.--Acres under Federal jurisdiction in the Northern Region on which MPB-caused mortality was aerially observed, 1992 and 1993.

	1992				1993			
Area	LPP[1]	PP	WBP	WWP	LPP	PP	WBP	WWP
Beaverhead NF	2,041	6	138	-	201	2	42	-
Bitterroot NF	8	66	-	-	22	349	2	-
Clearwater NF	121	-	-	1,255	562	4	-	64
Custer NF	-	40	2	-	199	179	2	-
Deerlodge NF	168	-	-	-	52	12	-	-
Flathead NF	4,129	28	80	2,623	2,546	115	32	270
Gallatin NF	275	-	160	-	2,019	2	67	-
Helena NF	291	36	44	-	232	78	10	-
IPNFs	1,264	28	12	6,662	1,992	475	-	532
Kootenai NF	31,616	782	48	533	4,817	472	-	590
Lewis & Clark NF	212	153	149	-	431	78	-	-
Lolo NF	15,928	803	2	54	15,267	999	-	71
Nez Perce NF	337	128	469	83	480	300	4	8
Total NF	**56,390**	**2,070**	**1,104**	**11,210**	**28,820**	**3,065**	**159**	**1,535**
Glacier NP	*	*	*	*	40	-	-	66
Yellowstone NP	*	*	*	*	946	-	-	-
Blackfeet IR	*	*	*	*	*	*	*	*
Crow IR	*	*	*	*	4	80	-	-
Flathead IR	380	1,128	-	-	658	7,229	-	-
Fort Belknap IR	76	143	-	-	*	*	*	*
N. Cheyenne IR	*	*	*	*	-	56	-	-
Nez Perce IR	294	310	-	-	-	73	-	-
Rocky Boy's IR	91	60	-	-	*	*	*	*
BLM (Total)	**313**	**47**	**54**	**114**	**151**	**118**	**6**	**-**
Total (Non-NF)	**1,154**	**1,688**	**54**	**114**	**1,799**	**7,556**	**6**	**66**
Total Federal	**57,544**	**3,758**	**1,158**	**11,324**	**30,619**	**10,621**	**165**	**1,601**

[1]LPP = Lodgepole pine; PP = ponderosa pine; WBP = whitebark pine; WWP = western white pine

* Not flown.

Table 2.--Acres of State and private ownership (within the following reporting areas) in the Northern Region on which MPB-caused mortality was aerially observed, 1992 and 1993.

	- - - - - - 1992 - - - - - -				- - - - - - 1993 - - - - - -			
Area	LPP[1]	PP	WBP	WWP	LPP	PP	WBP	WWP
Beaverhead NF	127	-	2	-	35	-	-	-
Bitterroot NF	2	68	-	-	8	306	-	-
Clearwater NF	2	-	-	16	-	-	-	4
Custer NF	-	2	18	-	4	19	-	-
Deerlodge NF	88	2	-	-	12	12	-	-
Flathead NF	121	-	-	60	190	504	-	573
Gallatin NF	-	2	26	-	485	10	4	-
Helena NF	84	77	4	-	100	186	2	-
IPNFs	57	278	-	429	48	16	-	28
Kootenai NF	540	64	-	20	75	70	-	60
Lewis & Clark NF	8	24	45	-	26	294	-	-
Lolo NF	749	170	2	-	1,527	547	-	2
Nez Perce NF	-	4	-	-	4	161	-	-
Garnets	18	132	-	-	40	211	-	-
Stillwater SF	48	2	10	261	6	-	-	358
Swan River SF	2	-	-	26	56	-	-	8
Thompson River SF	279	70	-	-	163	45	-	
Cataldo FPD*	-	8	-	96	9	26	-	2
CLW/Potlatch FPD		-	-	-	47	-	-	-
Craig Mtn. FPD*	54	483	-	-	621	554	-	-
Kendrick FPD*	18	-	-	-	2	-	-	-
Kootenai Valley FPD*	2	-	-	139	141	125	-	6
Maggie Cr. FPD*	4	33	-	-	2	4	-	-
Mica FPD*	181	131	-	18	206	446	-	4
Pend Oreille	121	36	-	144	199	107	-	62
Priest Lake		-	-	-	2	-	-	-
W. St. Joe	13	104	-	-	76	187	-	-
Total	**2,518**	**1,690**	**107**	**1,209**	**4,084**	**3,830**	**6**	**1,107**

[1]LPP = Lodgepole pine; PP = ponderosa pine; WBP = whitebark pine; WWP = western white pine

*FPD = Fire Protection District

Figure 2--MPB in Northern Region (all host species), 1993.

Western Balsam Bark Beetle (WBBB)

The beetle which has replaced the mountain pine beetle as the most prevalent in the Region is the WBBB. It has not, however, received the notoriety of the former--nor has it had the economic impact. Its host, primarily subalpine fir
(rarely grand fir), is not as important a timber species as are hosts of the mountain pine beetle. Also, due to the high-elevation sites most often affected, this beetle may never be deemed as "important" as MPB. It's affect on infested stands, which may well be in association with other pests, has not been accurately assessed, however. Because of the critical role these stands have in watershed protection and as habitat for many wildlife species--including threatened and endangered ones--the beetles' importance may be underestimated.

In northern Idaho, there was a reduction of infested area by more than half. In 1992, 3,400 acres showed some level of infestation; currently-faded subalpine firs were recorded on only 1,645 acres in 1993. In Montana, there was a virtually-static trend--slightly less than 60,000 acres were infested in 1992, compared to almost 59,900 acres in 1993 (Figure 3).

The most expansive outbreaks continue to be found on the Beaverhead (22,600 acres) and Gallatin (34,600 acres) NFs. We estimate approximately 40,000 trees were killed in 1992 (1993 faders), an average of less than a tree per acre. Though we began to monitor beetle populations in 1993, using pheromone-baited Lindgren funnel traps; to date, we know very little about the beetle's life cycle and population dynamics. It is, therefore, difficult to predict an infestation trend. If, as we suppose, the beetles' activity is correlated with availability of susceptible host, populations likely will remain high so long as old, decadent subalpine fir stands remain.

Douglas-fir Beetle (DFB)

Douglas-fir stands infested by DFB were also much reduced in 1993. In 1992, more than 24,000 acres had been affected, Region-wide. The infested area declined in 1993 to slightly more than 8,400 acres (Table 3 and Figure 4). In northern Idaho, the highest concentrations are on the Nez Perce NF, where 522 acres showed some level of infestation. Ground surveys there showed some still active populations, but a generally declining trend.

Nearly two-thirds of the area on which DFB was recorded, Region-wide, were in western Montana and Yellowstone National Park (NP). Though beetle populations appeared to be less active than in Idaho, currently infested stands were still found on the Gallatin and Helena NFs. Even where beetles were located, however, populations have declined from previous years due to sanitation/salvage efforts and a return to more nearly normal precipitation. In Montana, total infested area declined from 9,400 acres in 1992 to 4,900 acres in 1993. Also in 1993, another 1,480 acres were recorded in Yellowstone NP. An estimated 7,200 Douglas-fir were killed in Idaho; another 10,300 in Montana: 3.4 and 1.6 trees per acre, respectively. With few exceptions--notably on the Lincoln RD, Helena NF, and Livingston RD, Gallatin NF--and barring major stand disturbances, we anticipate areas affected by the beetle will continue to decline in 1994.

Western Pine Beetle (WPB)

Ponderosa pine stands infested by WPB showed more than a two-fold increase in northern Idaho in 1993, and close to that in western Montana (Figure 5). Still, populations are not as high as a few years ago when there were near-drought conditions in much of North Idaho. Nearly 4,000 acres were mapped in northern Idaho--about one-third on the Mica FPD, west of Coeur d'Alene. Other infestations were light, comprised of small groups, widely scattered. In all, approximately 13,300 ponderosa pines were estimated to have been killed--approximately 3.4 trees per acre.

Acres of infested ponderosa pine stands in western Montana were estimated to have nearly doubled, from 650 acres 1n 1992, to almost 1,200 in 1993. However, some of those WPB-infested stands were recorded from aerial surveys on the Lewis & Clark and Helena NFs. In our experience, WPB populations have not been confirmed east of the Continental Divide. Despite the apparent increase in infested acres, fewer trees per acre were killed in 1993 than the previous--less than one per acre.

Figure 3.--WBBR in Northern Region, 1993.

Table 3.--Aerially observed infested acres and mortality attributed to DFB in the Northern Region by reporting area, 1992 and 1993.

	1992			1993		
Reporting Area	Acres	Trees	Vol. (MBF)	Acres	Trees	Vol. (MBF)
Beaverhead NF	1,137	1,264	252.8	311	190	38.0
Bitterroot NF	1,251	4,954	1,708.4	1,025	407	335.4
Clearwater NF	2,215	5,049	1,767.2	103	488	170.8
Custer NF	100	226	45.2	562	711	142.2
Deerlodge NF	191	281	56.2	12	15	3.0
Flathead NF	570	701	210.3	510	907	272.1
Gallatin NF	4,573	4,355	871.0	1,034	1,182	236.4
IPNFs	2,691	5,249	1,837.2	384	1,545	540.8
Helena NF	927	2,377	475.4	503	1,104	220.8
Kootenai NF	486	505	151.5	589	1,155	346.5
Lewis & Clark NF	275	544	108.8	46	67	13.4
Lolo NF	685	1,397	419.1	606	1,051	315.3
Nez Perce NF	6,967	8,468	2,963.8	522	821	287.4
Glacier NP	*	*	*	214	483	144.9
Yellowstone NP	*	*	*	1,478	2,433	486.6
Garnets	112	188	56.4	44	92	27.6
Stillwater SF	0	0	0	2	5	1.5
Swan River SF	28	43	12.9	16	53	15.9
Thompson River SF	22	55	16.5	0	0	0
Coeur d'Alene IR	8	40	14.0	0	0	0
Crow IR	0	0	0	20	63	12.6
Flathead IR	80	257	77.1	156	295	88.5
Ft. Belknap IR	2	10	2.0	*	*	*
Nez Perce IR	229	921	322.4	9	35	12.3
Rocky Boy's IR	44	75	15.0	*	*	*
Cataldo FPD	69	210	73.5	39	107	37.5
CLW/Potlatch FPD	196	566	198.1	263	1,095	383.3
Craig Mtn. FPD	473	705	246.8	109	570	199.5
Kendrick FPD	537	2,555	894.3	250	990	346.5
Kootenai Valley FPD	12	10	3.5	6	9	3.2
Maggie Cr. FPD	42	104	36.4	18	60	21.0
Mica FPD	51	190	66.5	25	105	36.8
Pend Oreille	62	165	57.8	8	18	6.3
Priest Lake	10	45	15.8	59	295	103.3
W. St. Joe	226	875	306.3	143	525	183.8
Total	**24,271**	**42,384**	**13,282.2**	**9,066**	**16,876**	**5,033.2**

* Not flown.

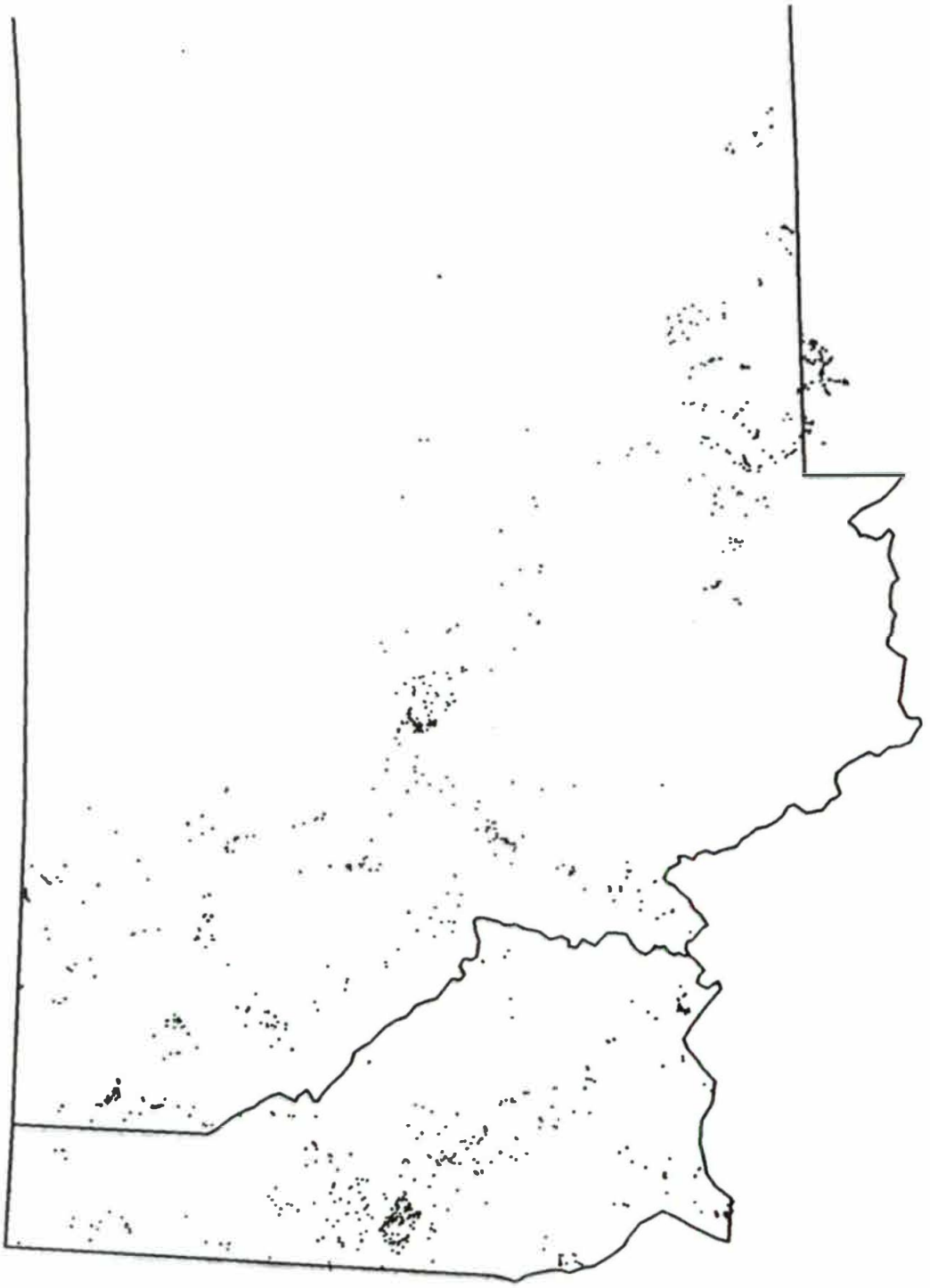


Figure 4--DFB in Northern Region, 1993.

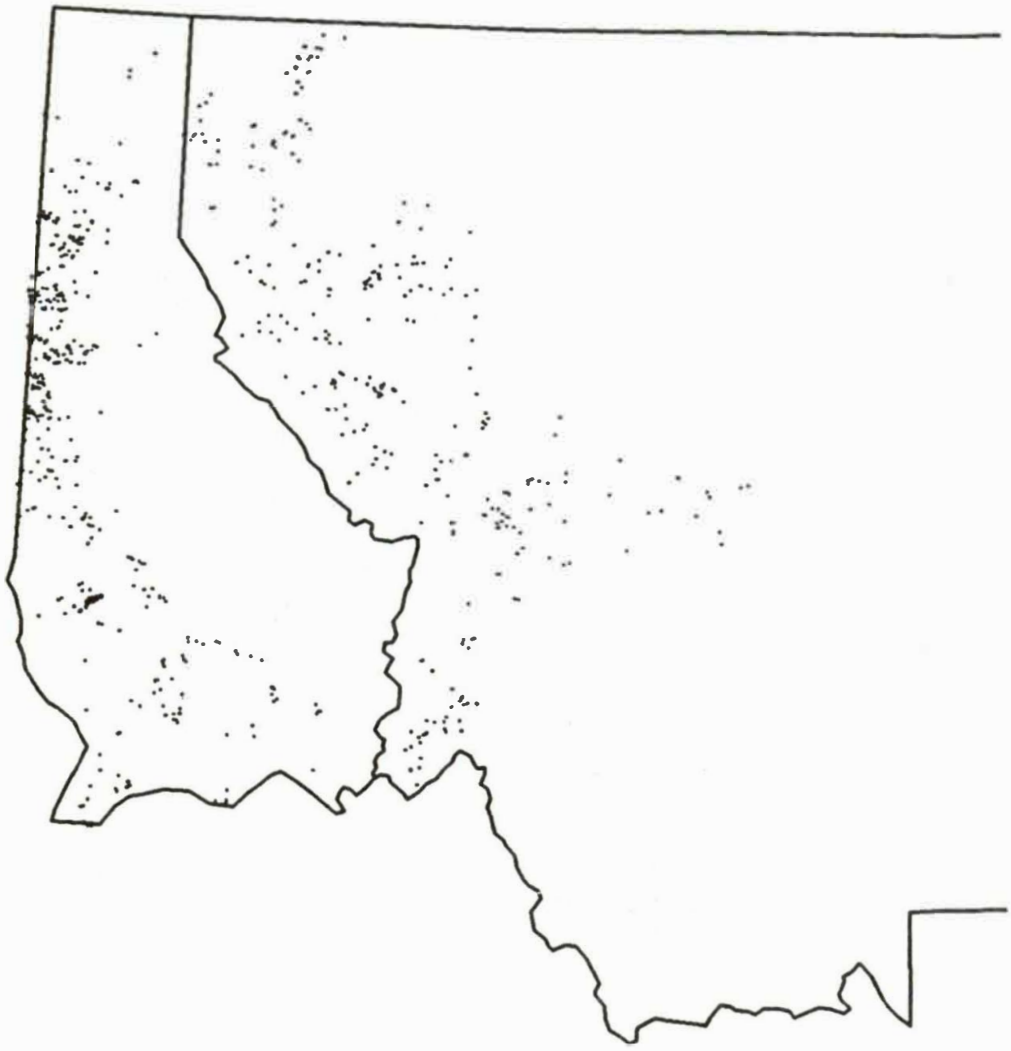


Figure 5.--WPB in Northern Region, 1993.

Western pine beetle is more weather dependent than most of our other bark beetle species. As such, population fluctuations are almost solely determined by precipitation and resultant condition of host trees.

Fir Engraver (FE)

Fir engraver, a pest almost exclusively of grand fir, is another primary tree killer but, like WPB, very dependent upon host condition. Populations tend to increase during periods of dry weather, but there is a more general association with root disease-affected grand fir stands. As such, populations of FE are maintained in many stands, particularly in northern Idaho, in "high" endemic conditions because of the prevalence of root diseases. Still, beetle populations declined significantly in Idaho--from 13,900 to 6,400 infested acres. Most of those acres were recorded on the Nez Perce NF, but some infested stands were observed in nearly all reporting areas (Figure 6).

Not as frequently found in Montana, FE is still common in weakened grand fir stands. Only recorded on 187 acres in 1993--almost all on the Lolo, Flathead, and Kootenai NFs--that was somewhat less than recorded in 1992. Close to 10,000 trees were estimated killed by the beetle--in both states--an average of about 1.5 per acre.

Pine Engraver (IPS)

Like FE, IPS beetles are more secondary tree killers. Populations tend to fluctuate with degree of stress in the host. They, however, are attracted to slash or other downed material and populations often build to epidemic conditions following the creation of slash and its mismanagement. Most often a problem in ponderosa pine, outbreaks in lodgepole pine are not uncommon following some type of stand disturbance. Serious outbreaks, and subsequent killing of standing green trees, occurred in and around Yellowstone NP following the fires of 1988. Those populations are finally declining--in response, for the most part, to improved moisture conditions. Where more than 27,000 acres had been infested on the Gallatin NF in 1992, only 5,900 acres were recorded in 1993. Total infested area in Montana was only 7,500 acres; almost all on the Gallatin and Custer NFs (Figure 7). Less than one tree per acre was estimated to have been killed.

In north Idaho, approximately 5,400 lodgepole pines were killed on less than 500 acres north of Coeur d'Alene. Those outbreaks are likely attributable to dry sites and stand disturbances.

IPS populations in ponderosa pine stands are essentially endemic, Region-wide. Only 400 total acres were recorded, in both States.

Spruce Beetle (ESB)

Except for an ongoing outbreak on the Gallatin NF near Cooke City, ESB populations are low throughout the Region. That epidemic developed from fire-weakened trees in and near Yellowstone NP, and is continuing in large-diameter, older spruce in the area. Currently existing on less than 300 acres, it is still threatening a large number of trees on Forest Service and private land. Slightly less than one tree per acre was killed in 1992.

Elsewhere in Montana, spruce mortality attributed to ESB was confined to small, 2- to 3-tree groups in a few high-elevation sites. Major outbreaks of ESB have not occurred in the State for nearly a decade.

In Idaho, a small outbreak which had existed in the southern portion of the Nez Perce NF has subsided; though one group, covering 90 acres and containing 40 trees, was observed on the Salmon River RD. Little other ESB-caused mortality was noted in northern Idaho.

Red Turpentine Beetle (RTB)

Red turpentine beetle is usually considered a minor pest of ponderosa and, occasionally, lodgepole pine. It is typically found attacking fire-weakened, or drought-stressed trees; or ones attacked by other, more

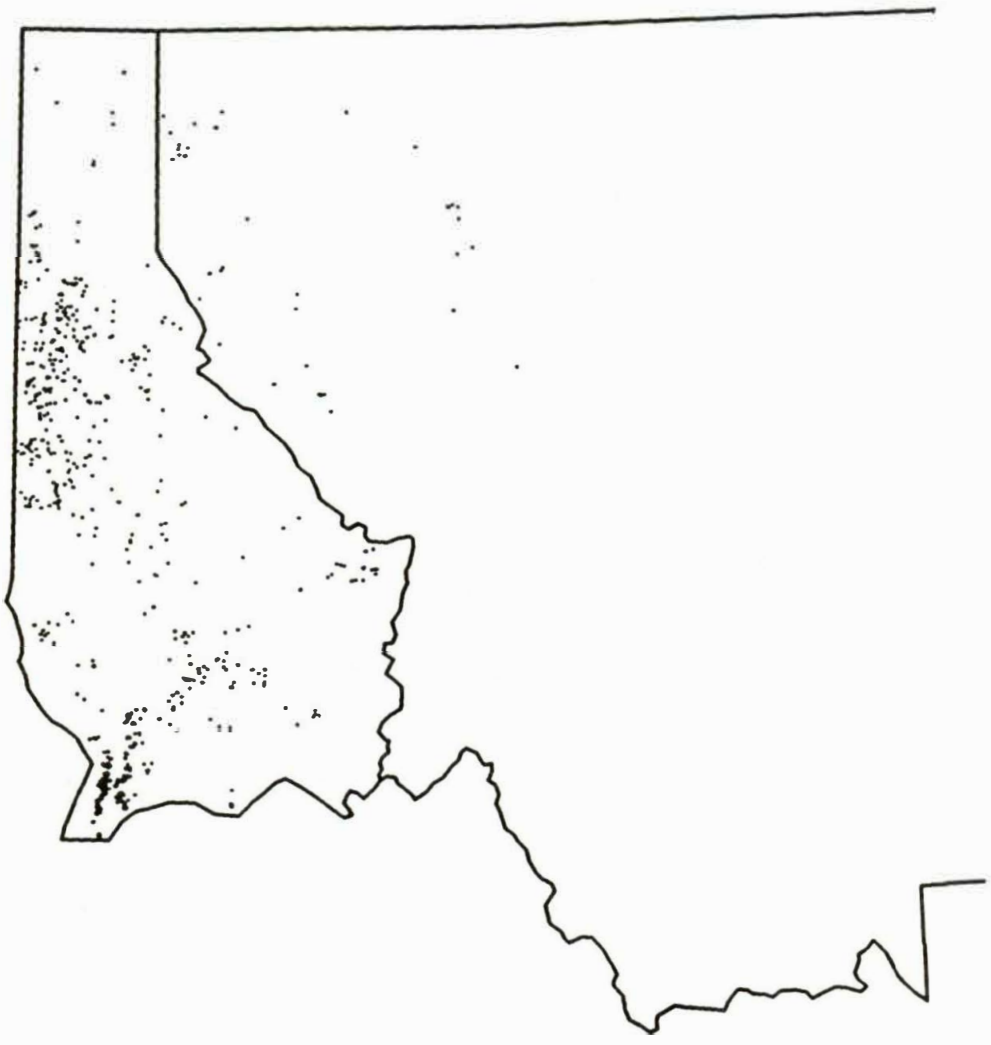


Figure 6.--FE in Northern Region, 1993.

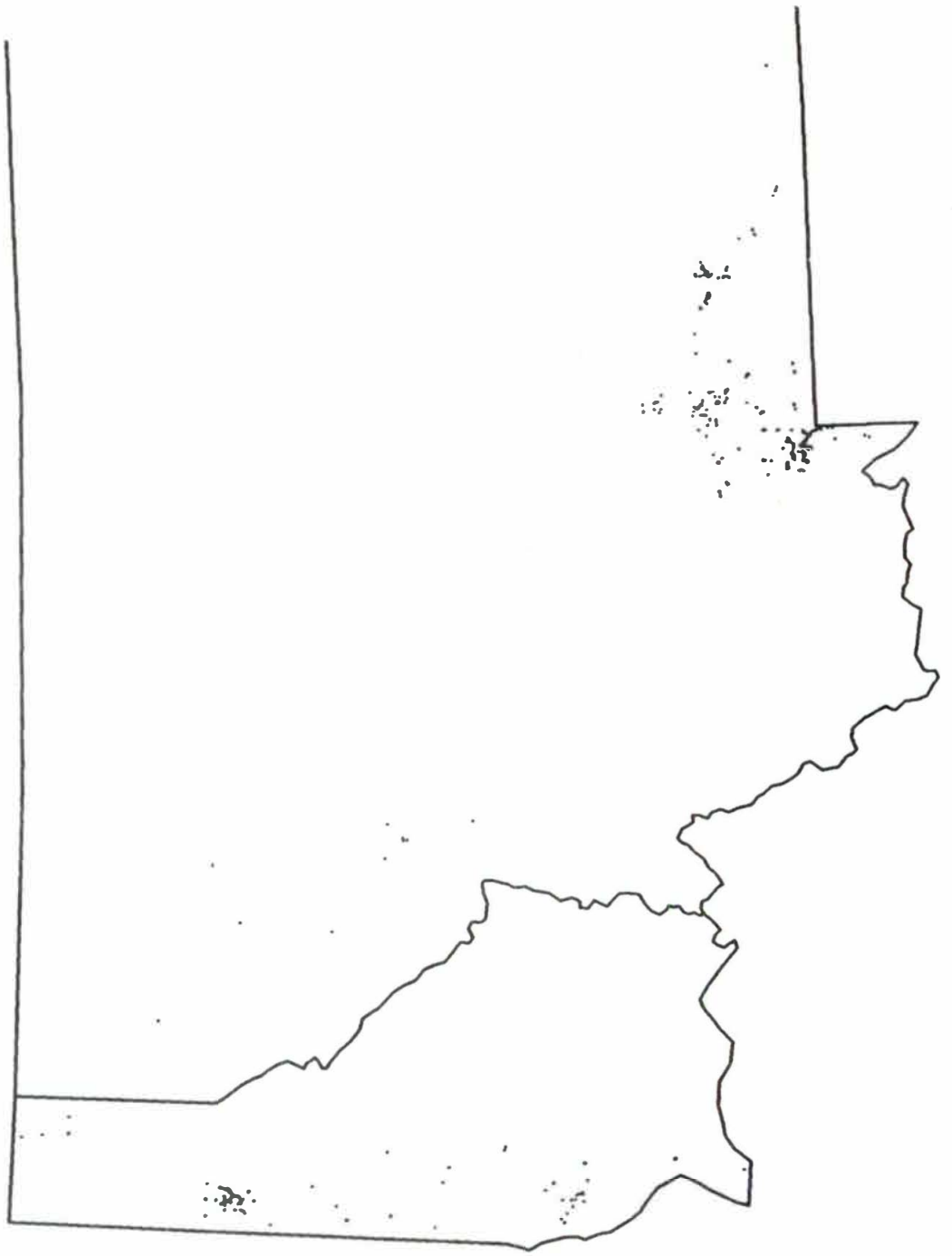


Figure 7.--IPS in Northern Region, (all host species), 1993.

"primary," bark beetles. We have observed them attacking small-diameter trees in ponderosa pine plantations during periods of drier-than-normal weather. In 1992, they were found to be causing serious amounts of mortality in a western white pine plantation which had been thinned and pruned to reduce effects of white pine blister rust.

In 1993, RTB continued to attack recently pruned western white pine ranging in size from 2 to 6 inches in diameter. Attacks have been found on the Palouse RD, Clearwater NF, and on the Fernan RD, IPNFs. In a Palouse RD plantation, 41 percent of the trees were attacked in 1992. Only 27 percent had new attacks in 1993. Mortality attributed to RTB also declined in that period, from 10 percent to 3.5 percent.

In five recently pruned plantations on the Fernan RD, beetle attacks were found in two to nine percent of the trees, but no beetle-caused mortality was noted. Diameter of attacked trees on that District averaged from 1.3 to 3.3 inches. We plan to continue surveying recently pruned white pine stands to determine the extent of the problem. In 1994, plantations on other Districts will be monitored in an effort to determine the extent of this phenomenon (Kegley 1994).

REPORTING AREA SUMMARIES

Beaverhead

Infestations of WBBB in high-elevation subalpine fir stands continued to be the most prevalent insect problem in the reporting area. Again this year, more than 22,600 acres were affected. Major concentrations were mapped in the Gravelly Range south of Ennis, Madison RD. Significant amounts were also mapped in the Tobacco Root Mountains and in the Jack Creek drainage, north of Ennis. Likewise, large groups of faded subalpine fir were noted in the Centennial Range, south of Red Rock Lakes, and in the Bitterroot Mountains on the western side of the Big Hole Valley, Wisdom RD. Lesser amounts were recorded in the Beaverhead Mountains, southwest of Dillon.

Almost insignificant amounts of other bark beetle infestations were noted throughout the area. Approximately 300 acres of each MPB in lodgepole pine and DFB in Douglas-fir were observed in small, widely scattered groups. The most concentrated area of DFB was in the Jack Creek drainage, on lands of mixed ownership.

Bitterroot

The most notable bark beetle outbreak in the Bitterroot reporting area was a DFB infestation in the River of No Return Wilderness, near Sabe Creek, in the Idaho portion of the West Fork RD. Though still encompassing more than 200 acres, it is down from just over 1,000 acres recorded in 1992.

Elsewhere, small, scattered groups of DFB-killed Douglas-fir, and ponderosa pine infested by MPB were observed in the West Fork Bitterroot River drainage, and in the foothills of the Bitterroot Mountains, south of Lake Como. Small groups of ponderosa pine faders–killed by a combination of MPB and WPB–were recorded in low-elevation stands on both sides of the Bitterroot Valley, from Hamilton north nearly to Lolo. Notable concentrations of ponderosa pine faders were in the Sapphire Mountains east of Hamilton, along the East Fork Bitterroot River, and throughout French Basin, east of Sula. Small groups of beetle-killed Douglas-fir and ponderosa pine were observed near Skalkaho Pass. Scattered groups of subalpine fir, killed by WBBB, were recorded on the Bitterroot/Beaverhead divide, above the East Fork.

In total, approximately 200 acres were infested by DFB and nearly 700 acres by MPB, in both ponderosa and lodgepole pine stands. Almost 200 acres of ponderosa pine were affected by WPB and less than 100 acres of subalpine fir were infested by WBBB.

Clearwater

Small, infrequent groups of DFB-infested Douglas-fir were observed north of Dworshak Reservoir, and east of Orofino on the North Fork RD. Also on the District, numerous groups of subalpine fir, killed by WBBB, were recorded near Fish Lake, close to the Montana border. Notable groups of grand fir, killed by FE; and

ponderosa pine, infested by WPB were mapped along the Clearwater River east of Kamiah. Widely scattered groups of faders--grand fir killed by FE and lodgepole/western white pine killed by MPB--were observed along the Lochsa River from Powell to Lowell.

Reporting area totals showed 560 acres of lodgepole pine faders; 520 acres of subalpine fir killed by WBBB; just over 100 acres of DFB-killed Douglas-fir; 116 acres of grand fir killed by FE; and 68 acres of dead western white pine, attributable to MPB. Most beetle-infested groups were small. No major infestation centers were observed.

Coeur d'Alene (IPNFs)
(Including Cataldo and Mica FPDs)

A few small groups of MPB-killed lodgepole pine, north of Lookout Pass; and Douglas-fir killed by DFB, near Murray Peak, were recorded on the Wallace RD. Other widely scattered groups of trees infested by FE, DFB, and MPB (lodgepole pine) were found south of the Coeur d'Alene River and north of St. Maries. Many small groups of faded trees occurred around the city of Coeur d'Alene and Coeur d'Alene Lake. Though most were small and scattered, some groups of lodgepole pines killed by IPS, north and east of Spirit Lake, contain 200 or more trees. In other parts of the reporting area, there are numerous small clusters of trees killed by MPB, WPB, and FE. Most groups varied in size from 1 to 20 trees.

In total, more than 230 acres of lodgepole pine have been affected by MPB and on another 460 acres lodgepole pines were killed by IPS. Approximately 625 acres of ponderosa pine were infested by MPB, and WPB killed ponderosa pines on an additional 1100 acres. DFB killed Douglas-firs on just 120 acres. Grand firs killed by FE were recorded on 365 acres and WBBB caused subalpine fir mortality on 135 acres.

Craig Mountains (Idaho)
(Including Nez Perce IR)

Many widely scattered, small groups of beetle-killed trees were still found throughout this reporting area. Groups of lodgepole pine were killed by MPB. In addition, MPB infested numerous groups of ponderosa pine. Most of that activity was recorded in the general vicinity of Soldiers Meadow Reservoir. Ponderosa pines were also killed by WPB and PE in the area. Most of the WPB activity was north of Craigmont.

Groups of Douglas-fir, killed by DFB were noted on the western edge of the area. Many of were on dry Douglas-fir sites above the Snake River Canyon. A few ground-checked sites showed generally declining populations.

Crow IR

A few, small (1- to 5-tree) groups of MPB-killed ponderosa pine were mapped in the Little Thompson Creek, Thompson Creek, Corral Creek, Cache Creek, and Spring Creek drainages. Some, widely scattered groups were also noted throughout the Wolf Mountains in the eastern portion on the Reservation. Though infested spots were numerous, total affected acres were only 80. During the mid-1980s, several thousand acres of ponderosa pine had been impacted. One small group of DFB-killed Douglas-fir was reported in the head of Corral Creek, but it's presence was not confirmed.

Custer

Major beetle outbreaks were not found on the Forest or surrounding lands of other ownership. There were, however, small infested spots throughout the area. MPB had infested ponderosa pine stands on the Ashland RD, west of Fort Howes; and in the Ekalaka Hills and Slim Buttes on the Sioux RD. None of those small outbreaks appeared to be increasing.

On the Beartooth RD, near Red Lodge, subalpine fir were killed by WBBB, and lodgepole pine were infested by IPS in the Rock Creek drainage. Also, a few groups of Douglas-fir infested by DFB and subalpine fir killed by WBBB were found in the Pryor Mountains east of Red Lodge.

Deerlodge

At one time, a major MPB outbreak existed north of Homestake Pass, in the vicinity of Delmoe Lake. That infestation has completely subsided. No faders were observed there in 1993. A few, small groups of lodgepole pine, killed by MPB, were noted west of Boulder, Jefferson RD. A significant amount of lodgepole pine in that area is of a susceptible age and size class. Those populations did not appear to be building, however.

East of Rock Creek, on the Philipsburg RD, small 1- to 5-tree groups of ponderosa pines, attacked by either MPB or WPB, were mapped. A few lodgepole pines killed by MPB were also noted.

Flathead

One of the more active MPB infestations in the Region remains in the Crane Mountain area, Swan Lake RD (Figure 8). Though many lodgepole pine stands between Flathead Lake on the west, and Swan Lake on the east, were infested--and many trees were killed in 1993--data collected (Table 4) indicated the outbreak should begin declining soon. Because many small-diameter trees were attacked, a subsequent decrease in brood production will result in infestation decline. Beetle populations in that area, however, could be a significant management concern for a few more years. Also, on the Swan Lake RD, near Jewell Basin, and south along the Swan River, small groups of beetle-killed grand fir, Douglas-fir, and lodgepole pine were found. West of Kalispell, scattered groups of lodgepole and ponderosa pine, killed by MPB, remain south of Ashley Lake. These are but small remnants of the once extensive outbreak in that area. South of there, east of Lake Mary Ronan, several small groups of ponderosa pine faders were noted.

Numerous scattered, but small groups of MPB-killed lodgepole pine were observed along the west side of Hungry Horse Reservoir from Meadow Creek Campground, northwest to Hungry Horse. Several groups of western white pine, also killed by MPB were mapped along the Reservoir, from about Peters Creek to the Dam. Ground-collected data showed a slight decline in infested trees in 1993. Also on the Hungry Horse RD, east of Hungry Horse, small amounts of DFB-killed Douglas-fir were noted. In that same general area, but more along the Middle Fork Flathead River, groups of lodgepole and western white pine were killed by MPB.

On the Spotted Bear RD, ground data revealed a slowly building population of MPB in lodgepole pine (Table 4). Data were collected from plots near the Ranger Station and along the South Fork Flathead River. A set of 30 permanent plots were established in 1979, southeast of the Ranger Station, along Cedar Creek. Though comprised of lodgepole pine susceptible to MPB, outbreak beetle populations have never developed in those stands.

On the Glacier View RD, in stands along the North Fork Flathead River, there were scattered groups of subalpine fir killed by WBBB; Douglas-fir killed by DFB; and western white pine killed by MPB. None are in high concentrations, but most of the western white pine mortality is in the Canyon Creek drainage, east of Whitefish Lake (State and private land), and along Coal Creek.

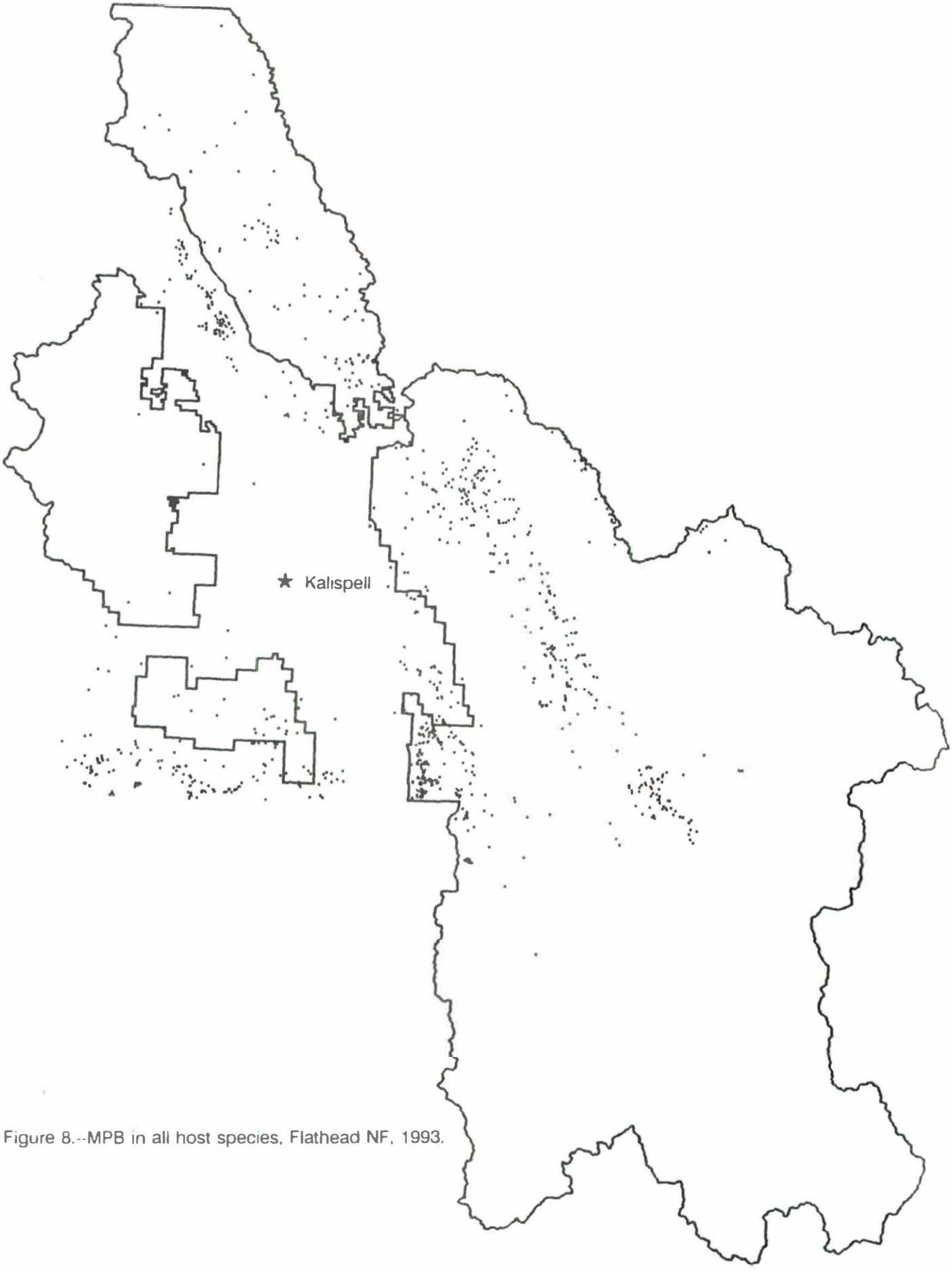


Figure 8.--MPB in all host species, Flathead NF, 1993.

Table 4.--Acres of host infested and pine species per acre killed by MPB
Flathead reporting area, 1992 and 1993.

		- - - Acres infested - - -		- - - Average no. trees/acre killed - - -			
Ownership	Host	1992	1993	Older	1992	1993	To date
Glacier View RD	LPP	266	34	-	-	-	-
	PP	4	2	-	-	-	-
	WBP	52	24	-	-	-	-
	WWP	93	119	-	-	-	-
Hungry Horse RD	LPP	745	502	63.1	42.8	33.7	139.6
	WBP	16	4	-	-	-	-
	WWP	2,123	96	-	-	-	-
Spotted Bear RD	LPP	345	291	6.9	6.5	12.8	26.2
	PP	0	4	-	-	-	-
	WBP	8	4	-	-	-	-
	WWP	175	16	-	-	-	-
Swan Lake RD	LPP	2,765	1,718	13.0	15.9	65.1	94.0
	PP	24	109	-	-	-	-
	WBP	4	0	-	-	-	-
	WWP	233	40	-	-	-	-
Tally Lake RD	LPP	8	2	-	-	-	-
State, private, other	LPP	121	190	-	-	-	-
	PP	94	504	-	-	-	-
	WWP	60	573	-	-	-	-
Total/weighted avg.	**LPP**	**4,250**	**2,737**	**16.5**	**15.8**	**44.2**	**76.5**
	WWP	**2,684**	**844**		**-**	**-**	**-**
Species Total		**7,136**	**4,232**				

Flathead IR

Many 5- to 20-tree groups of lodgepole pine, infested by MPB, were observed east of Flathead Lake. Several small groups of ponderosa pine faders, also killed by MPB, were mapped in the Hellroaring Creek drainage, near the southeastern tip of Flathead Lake. From there, south to the southern boundary of the Reservation, along the foothills of the Mission Mountains, scattered ponderosa pine mortality was noted. MPB-killed ponderosa pines were also found west of Flathead Lake to Niarada, and along the western Reservation boundary. More widely scattered were a few MPB-killed lodgepole pine and WPB-infested ponderosa pine.

Several, more-concentrated groups of beetle-killed lodgepole pines were mapped in the vicinity of Bassoo Peak.

Total affected area on the Reservation was more than 7,200 acres of ponderosa pine and 650 acres of lodgepole pine. The acreage of infested ponderosa pine was more than six times that recorded in 1992.

Doulgas-fir stands infested by DFB totalled just over 150 acres. Most were located east of St. Ignatius, near Mission Reservoir and St. Marys Lake.

Gallatin

The most significant WBBB outbreaks in the Region occurred in this reporting area, with more than 34,000 acres affected. Large infested groups were observed in the Gallatin Canyon, roughly from West Yellowstone north to Bozeman. Some of the largest groups were found in the headwaters of Taylor Creek and along the West Fork Gallatin River. In the Madison Range to the west, and to the east in the Gallatin Range, scattered groups of IPS- and/or MPB-killed lodgepole pine were noted. Also observed were MPB-killed whitebark pine and a few Doulgas-fir killed by DFB. On the Bozeman RD, near Hyalite Canyon, there were groups of lodgepole pine infested by IPS. Those infestations extended east to Mystic Lake and towards Bear Canyon. DFB- and IPS-killed groups of faders were found west to Antelope Butte.

On the Gardiner RD, near Jardine, there were numerous groups of subalpine fir killed by WBBB. Other groups were seen in the Absaroka Range, east of the Yellowstone River. Large groups of subalpine fir mortality, as well as a significant outbreak of ESB in Engelmann spruce, were noted along Soda Butte Creek near Cooke City. The ESB epidemic, likely begun in fire-weakened trees after the Yellowstone fire of 1988, is killing trees on both Federal and private lands in the area.

In the Boulder River corridor, Big Timber RD, groups of lodgepole pine--killed by both MPB and IPS--subalpine fir, and Douglas-fir mortality were observed. None of those outbreaks appear to be expanding rapidly. However, a few groups of DFB are still active. South of Big Timber, near Castle Butte, Gold Hill, and Hicks Mountain, groups of MPB-killed lodgepole pine were found.

Finally, the DFB outbreak in the Mill Creek drainage, Livingston RD, is still quite active. Though the infested area declined in 1993, numerous trees attacked in 1993 were found in some groups. In one group, near the East Fork of Mill Creek, 78 successfully attacked trees were recorded. Infested trees in some of those groups are of small diameter--an indication of a decidedly declining trend. Aggressive sanitation/salvage efforts--including the use of pheromone tree baits for DFB--continued in that area. Those continuing activities should help reduce beetle populations to endemic status.

Garnet Mountains (Montana)

No significant beetle outbreaks occurred in the reporting area. However, widely scattered groups of MPB-killed ponderosa pine were observed. Highest concentrations of beetle-caused mortality was north and east of Potomac and near Bearmouth, along Interstate 90. A few, small groups of MPB-killed lodgepole pine and DFB-killed Douglas-fir were also observed. A very few ponderosa pines, apparently killed by WPB were recorded near Milltown.

Helena

Though acres of DFB-caused mortality declined in 1993, DFB remained the most important bark beetle pest on the Forest and surrounding lands of other ownerships. The DFB outbreak on the Lincoln RD, and adjacent private and BLM-administered lands, declined from about 900 acres in 1992 to just over 500 acres in 1993. Still, active beetle populations were found in some areas. BLM, State and private lands in the vicinity of Marcum Mountain, west of Lincoln are still infested, though those populations were reduced from previous years. Other stands in that general area--Kershaw Mountain, Trapper Mountain, and in the Arastra Creek drainage, and several sites south of Highway 200--still contained recently and currently infested trees. In the Copper Creek drainage, east of Lincoln, ground evaluations detected very active beetle populations. In two plot areas, 63 and 48 newly-attacked trees were recorded. In addition, scattered groups of lodgepole pine killed by MPB and subalpine fir attacked by WBBB were found on the District.

On the Helena RD, several groups of ponderosa pine killed by MPB were observed. Notable were stands in the South Fork Dearborn Creek, along Prickley Pear Creek, and west of Holter Lake. Scattered, small groups of WBBB-killed subalpine fir, and MPB-killed lodgepole pine were mapped east of Canyon Ferry Lake. A few MPB-infested groups of lodgepole pine were observed near the head of Deep Creek in the Big Belt Mountains. Other small, and widely scattered groups of faders--mostly ponderosa pine, lodgepole pine and subalpine fir--were mapped south and west of Helena. Most were observed in tributaries of the Little Blackfoot River and Little Prickley Pear Creek.

A small amount of DFB-killed Douglas-fir and MPB-killed lodgepole pine were noted in the Crow Creek drainage, west of Townsend, on the Townsend RD. No other beetle outbreaks were observed on the District in 1993.

Kaniksu (IPNFs)
(Including Kootenai Valley, Pend Oreille, and Priest Lake FPDs)

MPB and WBBB infestations were the major bark beetle concerns throughout the reporting area. On the Bonners Ferry RD, WBBB-infested subalpine fir stands totalled 1,900 acres and were scattered in numerous high-elevation stands in several drainages west of the Kootenai River. Most of the MPB activity was confined to lodgepole pine stands in the Boulder River drainage, east of Bonners Ferry. Ground surveys there showed one plot area, near Katka Creek, with nearly 20 new attacks per acre. In other plots, a population decline was indicated. Approximately 1,920 acres were infested, District-wide. From there, south to the Sandpoint RD, scattered stands of lodgepole pine infested by MPB and subalpine fir stands affected by WBBB were found east of Highway 95.

On the Priest Lake RD, near Upper Priest Lake, stands of subalpine fir were observed which contained significant amounts of WBBB-caused mortality. More than 500 acres were recorded on the District.

Federal lands on the Sandpoint RD, as well as lands of other ownership west of Lake Pend Oreille, showed scattered groups of subalpine fir faders, killed by WBBB, and western white pine which had been killed by MPB. Small groups of ponderosa pine, some infested by MPB, others by WPB, were mapped throughout the reporting area. Almost 600 acres of the former were recorded; approximately half that of the latter.

Kootenai

As recently as 1992, the Kootenai NF and surrounding State and private lands harbored the most extensive MPB outbreaks in the Region. Because of management activities which have reduced infested and susceptible hosts, and a generally declining trend for the past few years, infested acres in the reporting area were less that one-sixth those recorded in 1992. In 1993, less that 5,000 acres of lodgepole pine stands showed some level of MPB activity (Figure 9). On the Rexford RD, large groups of faders were found in Sutton Creek and Big Creek drainages. Other, smaller groups were numerous around Lawrence Mountain. Groups of

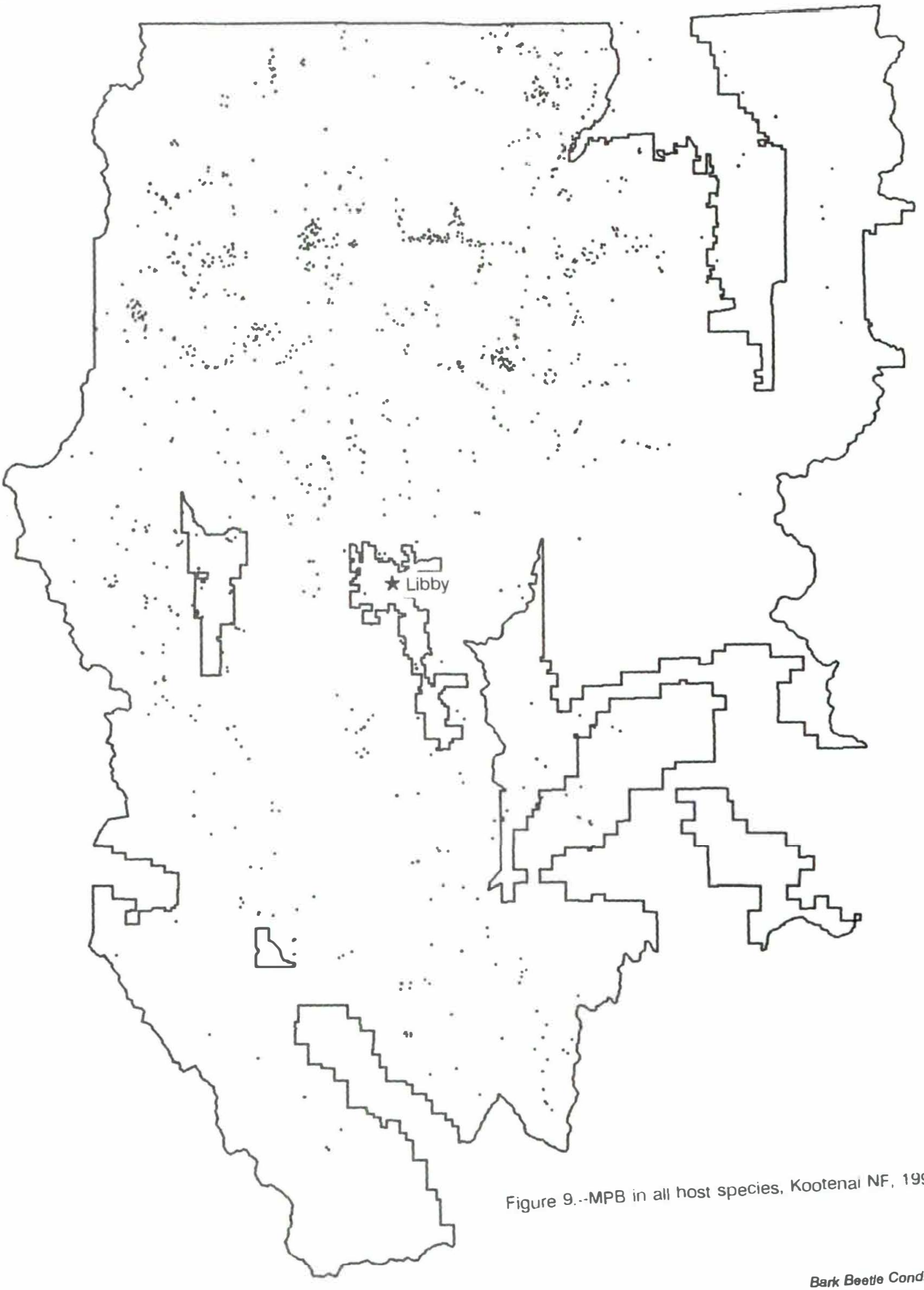


Figure 9.--MPB in all host species, Kootenai NF, 1993.

MPB-killed ponderosa pine were found on the District, scattered along both sides of Lake Koocanusa. Ground-collected data (Table 5) showed a markedly declining trend.

On the Three Rivers RD, active MPB groups were located near Newton Mountain and Conn Mountain. Smaller, more infrequent groups were recorded in the Upper Yaak, near Young Creek and Dodge Creek. Groups of western white pine, killed by MPB were mapped throughout the District, particularly in the lower Yaak River drainage. West of Bull Lake, several groups of DFB-caused mortality were recorded. That infestation has not been ground checked, so population trend has not been determined. A small, but active ESB outbreak in the Vinal Creek drainage was reported, but has not yet been evaluated.

The Libby RD had numerous widely scattered groups of trees killed by MPB. Notable were groups of western white pine in the vicinity of Bobtail Ridge, Quartz Creek, and Big Hoodoo Mountain. Also on the District were infestations of WPB in ponderosa pine, FE in grand fir, and WBBB in subalpine fir.

Elsewhere in the reporting area, small, 1- to 20-tree groups of bark beetle-caused mortality were recorded: MPB in lodgepole pine; WPB and MPB in ponderosa pine; and DFB in Douglas-fir. None were considered to be major management concerns.

Lewis and Clark

While bark beetles were not seriously affecting stands in the reporting area, some ponderosa pines stands have been infested by MPB. On BLM-administered lands north of Lewistown, small, scattered groups of faders were observed. We noted other MPB-impacted ponderosa pine stands in the western portion of the Big Snowy Mountains, and throughout the Little Snowy Mountains, north to Flatwillow Creek. Those stands, located on both the Judith and Musselshell RDs, totalled less than 100 acres. In other parts of the Judith RD, principally the Castle Mountains, and northward into the Highwood Mountains, a few groups of MPB-killed lodgepole pine and WBBB-affected subalpine fir were seen. Reporting area totals showed just over 400 acres of dead ponderosa pine, another 450 acres of lodgepole pine faders.

On the Kings Hill RD, scattered between Logging Creek and Kings Hill, and in other portions of the Little Belt Mountains, minor amounts of subalpine fir killed by WBBB and lodgepole pine killed by MPB were mapped. Scattered groups of DFB-killed Douglas-fir totalled less than 30 acres on the District.

Lolo

The most active and extensive MPB outbreak in the Region continued on the Lolo NF in 1993 (Figure 10). Most severely affected were lodgepole pine stands in the Little Thompson River drainage, along the divide between Plains and St. Regis, and east of Copper King Campground in the Thompson River corridor. Those affected stands were for the most part on the Plains/Thompson Falls RD; but infestations south of Plains extended onto the Superior RD. South and east of Plains, numerous ponderosa pines have been killed by MPB. On the Plains/Thompson Falls RD, more than 12,000 acres of lodgepole pine have been infested by MPB. Another 200 acres of ponderosa pine have been affected. Data collected on ground plots (Table 6) showed high numbers of trees killed in 1993, but much less than in 1992. Plot averages indicated about half as many this year as last, down from 29 trees per acre to less than 15.

Also on the Superior RD, significant MPB infestations occur in lodgepole pine stands in the Tamarack Creek drainage, and in ponderosa pine stands east of St. Regis. Minor amounts of beetle-infested lodgepole pines were observed in the Prospect Creek drainage, but much susceptible lodgepole pine exists there and we anticipate beetle populations could expand in the next few years.

Table 5.--Acres infested and trees per acre killed by MPB, Kootenai reporting area, 1992 and 1993.

	- - - - Acres infested - - - -			- - - Average no. trees/acre killed - - -			
Ownership	Host	1992	1993	Older	1992	1993	To date
Cabinet RD	LPP	556	128	-	-	-	-
	PP	46	4	-	-	-	-
	WWP	84	44	-	-	-	-
Fisher River RD	LPP	93	33	-	-	-	-
	PP	102	69	-	-	-	-
	WWP	16	36	-	-	-	-
Fortine RD	LPP	80	18	-	-	-	-
	PP	10	2	-	-	-	-
	WBP	28	0	-	-	-	-
	WWP	29	0	-	-	-	-
Libby RD	LPP	3,740	95	-	-	-	-
	PP	32	62	-	-	-	-
	WWP	82	98	-	-	-	-
Rexford RD	LPP	17,510	2,600	96.3	24.0	0.4	120.7
	PP	386	107	-	-	-	-
	WBP	20	0	-	-	-	-
	WWP	81	88	-	-	-	-
Three Rivers RD (Yaak)	LPP	980	855	9.4	12.5	2.7	24.6
	PP	32	162	-	-	-	-
	WWP	64	212	-	-	-	-
Three Rivers RD (Troy)	LPP	8,657	1,088	-	-	-	-
	PP	174	66	-	-	-	-
	WWP	177	112	-	-	-	-
State, private, other	LPP	540	79	-	-	-	- -
	PP	64	70	-	-	-	-
	WWP	20	60	-	-	-	-
Total/weighted avg.	**LPP**	**32,156**	**4,896**	**64.7**	**19.8**	**1.2**	**85.7**
	PP	**846**	**542**	**-**	**-**	**-**	**-**
	WWP	**553**	**650**	**-**	**-**	**-**	**-**
Species total		**33,603**	**6,088**				

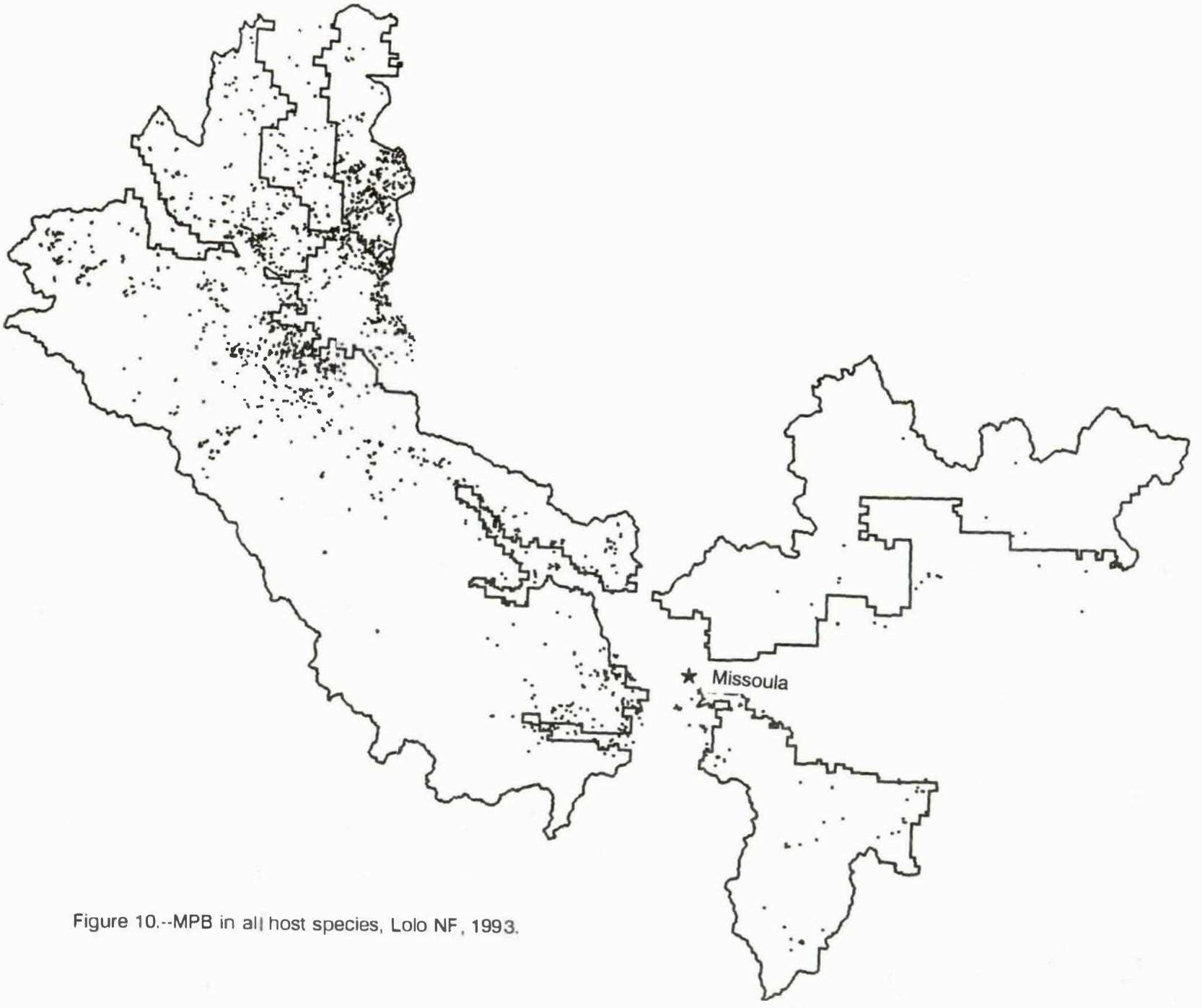


Figure 10.--MPB in all host species, Lolo NF, 1993.

Table 6.--Acres infested and trees per acre killed by MPB, Lolo reporting area, 1992 and 1993.

	- - - - Acres infested - - - -			- - - Average no. trees/acre killed - - -			
Ownership	Host	1992	1993	Older	1992	1993	To date
Missoula RD	LPP	13	18	-	-	-	-
	PP	32	327	-	-	-	-
Ninemile RD	LPP	72	184	20.9	17.5	7.1	45.5
	PP	276	446	46.2	17.8	13.6	77.6
	WWP	0	2	-	-	-	-
Plains RD	LPP	10,266	10,140	32.8	39.6	16.8	89.2
	PP	66	99	-	-	-	-
	WWP	2	4	-	-	-	-
Seeley Lake RD	LPP	2	6	-	-	-	-
	PP	0	4	-	-	-	-
Superior	LPP	2,419	2,338	8.8	20.8	15.5	45.1
	PP	415	42	-	-	-	-
	WWP	26	49	-	-	-	-
Thompson Falls RD	LPP	3,158	2,582	-	-	-	-
	PP	14	81	-	-	-	-
	WBP	2	0	-	-	-	-
	WWP	26	16	-	-	-	-
Garnet Mountains	LPP	18	52	-	-	-	-
	PP	144	235	-	-	-	-
State, private, other	LPP	764	1,582	-	-	-	-
	PP	170	555	-	-	-	-
	WBP	2	0	-	-	-	-
	WWP	0	2	-	-	-	-
Total/weighted avg.	**LP**	**116,712**	**16,902**	**22.1**	**29.2**	**14.8**	**66.1**
	PP	**1,117**	**1,789**	**46.2**	**17.8**	**13.6**	**77.6**
Species total		**17,887**	**18.764**				

Small and scattered groups of lodgepole and ponderosa pine faders--killed by MPB--were noted on the Ninemile RD. Only a few years ago the site of major MPB outbreaks, infested stands now total but 450 acres of ponderosa pine and less than 200 acres lodgepole pine on the District.

On the Missoula RD, only widely scattered stands affected by bark beetles were recorded. Some infested lodgepole pine stands remain in the Mill Creek drainage, A few were observed along Lolo Creek. Scattered ponderosa pine faders were noted throughout low-elevation stands west of Missoula, and into the Lolo Creek drainage. East of Missoula, along the Clark Fork River, minor amounts of ponderosa pine, killed by either MPB or WPB, and DFB-killed Douglas-fir were observed. Elsewhere on the Forest, only small amounts of beetle-impacted stands were occasionally seen.

Nez Perce

With the exception of WBBB, which increased slightly–from 800 acres to almost 950--most bark beetle-infested areas on the Forest and surrounding lands declined in 1993. Significant decreases in DFB- and FE-caused mortality were recorded. In 1992, nearly 7,000 acres had been affected by DFB. In 1993, only 522 acres were noted. The number of FE-infested acres decreased by nearly half in 1993--from 7,400 to just over 4,300. Slight increases were recorded in the number of stands in which trees have been killed by MPB, both lodgepole and ponderosa pines. Both, however, are far below historic infestation levels.

Many large groups of grand fir, killed by FE, were observed on the Salmon River RD, east of the Salmon River, from Riggins north to Skookumchuck Creek. In that same general area, between Riggins Hot Springs and Grangeville, much scattered FE-killed trees and some ponderosa pines, killed by either MPB or WPB, were mapped. A few small groups of Douglas-fir, infested by DFB, were likewise noted.

On the Red River RD, along Running Creek, noticeable amounts of WBBB- and FE-caused mortality, in subalpine fir and grand fir respectively, were recorded. On the Selway RD, scattered groups of grand fir, killed by FE, were observed along the Lochsa River, south and east of Kooskia, and in the Meadow Creek drainage. In the latter, minor amounts of WPB-killed ponderosa pine were also noted. On the Elk City RD, along the Red River, south of Elk City, some groups of lodgepole pine, infested by MPB were found. On other sites there, subalpine fir had been killed by WBBB.

Northern Cheyenne IR

Small, and widely scattered groups of ponderosa pine faders were mapped along the western edge of the Reservation--in West Fork Muddy Creek, Busby Creek, Trail Creek and Skunk Creek drainages. Group size ranged from one to five trees. A few small groups were also recorded south and east of Lame Deer. Total infested acres were only 56. Though this mortality was attributed to MPB, and that is a possibility; it is likely to be IPS-caused mortality. Serious IPS outbreaks have occurred on the Reservation for several years. A continuing study on the Reservation is attempting to determine which species of *Ips* are present, flight periodicities, and management alternatives to reduce beetle-caused mortality.

St. Joe (IPNFs)

Bark beetle outbreaks were generally light, and scattered throughout the reporting area. The most noticeable was WBBB, which was recorded killing subalpine fir in stands in the eastern portion of the Avery RD--along the St. Joe River and east into the Bitterroot Mountains.

In other areas, mostly on the St. Maries RD, and surrounding State or private lands, bark beetle outbreaks were less frequent. Scattered groups of WPB-killed ponderosa pine and FE-affected grand fir were observed from about Worley, south towards Moscow, and in the Little Hangman Creek and Middle Fork Deep Creek drainages. Some effects of DFB and FE infestations were noticed north of Harvard, along Mannering Creek, and near Benewah Creek, northward to Coeur d'Alene Lake.

BARK BEETLE TECHNOLOGY DEVELOPMENT PROJECTS

During 1993, we conducted three projects to evaluate the effectiveness of pheromones in manipulating beetle populations to our advantage. In all three, we were attempting to evaluate the properties of anti-aggregating pheromones as protectants for uninfested green trees, or slash. A brief description of the projects and preliminary results follow:

Verbenone and Ipaenol aa Anti-Aggreganta of Pine Engraver

In this test, conducted in ponderosa pine stands on private land, northeast of Missoula, we were evaluating the effectiveness of aggregating pheromones of competitor beetles as anti-aggregants of the pine engraver (specifically, *Ips pini* [Say]). Applied in bubble-capsule formulations, one each of verbenone and ipsenol, we treated freshly-created slash piles with four treatments of paired capsules.

Treatments were: no capsules (controls), 5 paired capsules, 10 paired capsules, and 15 paired capsules per slash pile. Each treatment was replicated four times. An identical project was repeated in northern Idaho, near Coeur d'Alene.

Slash piles were created and treated on April 15-16. Evaluation was completed during the week of June 21. Due to the cold and wet spring and summer, beetle flights were somewhat atypical this year. Still, some treatment effect was noticed. Unanalyzed results, showing IPS attacks per square foot of sampled bark, are shown in the following table:

REP	IDAHO TREATMENT				MONTANA TREATMENT			
	0	*5*	*10*	*15*	*0*	*5*	*10*	*15*
1	20.8	12.2	5.8	3.1	6.2	4.0	3.4	4.3
2	16.4	7.5	9.1	17.3	6.4	2.9	4.1	6.8
3	14.4	6.4	13.6	8.4	4.5	3.6	2.1	2.4
4	15.3	16.9	8.7	15.9	5.5	1.3	1.1	1.3
AVG.	16.7	10.8	9.3	11.2	5.7	3.0	2.7	3.7

Treatment effect was not as pronounced as we had hoped. And yet, because results were promising, we plan to repeat the test in 1994. We hope to repeat the test as done in 1993, but with better monitoring of flight period so evaluation can be done following initial flight of the season. And, it will be nice if we have more typical weather in 1994!

Aerial Application of MCH to Protect Standing Green Douglas-fir

Methylcyclohexanone (MCH), the anti-aggregating pheromone of Douglas-fir beetle has proven effective in preventing beetle attacks in windthrown Douglas-fir (McGregor, et al, 1984). We had hoped to evaluate its effectiveness in protecting standing, uninfested Douglas-fir that were threatened by beetle populations in nearby blowdown. We conducted the project on the Kootenai NF, Libby RD, north of Libby. Using a combination of ground-collected data, stand-exam information, and recent aerial photographs, we selected 17, 10-acre blocks. The project area was in the Purcell Mountains, near Big Creek Baldy Mountain, and comprised approximately 13,000 acres in total area.

Blocks were treated on April 21 using a helicopter and underslung, modified fertilizer spreader (see cover illustration). Treatment was MCH-impregnated polymer beads, applied at the following rates: none (control); 10 grams MCH per acre; 30 grams per acre; and 100 grams per acre. The 30-gram treatment was equivalent to the "standard" treatment of 4 pounds of beads (containing 2 percent MCH) per acre. The

10-gram treatment comprised one-third the amount of "loaded" beads and additional "blank" beads to equal 4 pounds/acre. Blocks receiving the 100-gram treatment were flown three times. Each treatment was replicated three times. Five blocks received no beads and served as controls.

Treatment evaluation was conducted during the week of September 13. Unfortunately, there were insufficient beetle attacks in any of the blocks to accurately assess treatment effect. We believe the abnormally cool and wet summer sufficiently disrupted, or prolonged, beetle flight in that area to significantly reduce populations. We were able to show that plot selection and treatment were logistically successful. The determination of MCH's ability to protect standing, green Douglas-fir, however, awaits a future project.

Aerial Application of Verbenone to Protect Uninfested Lodgepole Pine

Verbenone has been shown to be one of the important anti-aggregants of mountain pine beetle. It has been tested, with mixed results, as a means of protecting lodgepole pine stands from beetle attack until silvicultural manipulations could be used to reduce stand susceptibility. Previous tests, conducted in our Region and other areas in the United States and Canada, using both aerial and ground applications of verbenone, had shown cause for optimism that this is a potentially valuable management technique (Gibson 1994).

This year's test, on the Superior and Plains/Thompson Falls RDs, Lolo NF, was an effort to reproduce one of our more successful tests, conducted in 1988 in northwest Montana. This year, as then, we aerially applied 4 pounds per acre of verbenone-impregnated polymer beads with the same helicopter/underslung bucket system used in the MCH test. We had selected 11, 20-acre blocks which met selection criteria for amount of MPB-infested trees and remaining green ones. Six of the blocks received bead applications. Five additional blocks served as controls.

Bead application was made twice, once before beetle flight, June 30 and the second during beetle flight, August 4. The second application was deemed necessary because bead analysis showed much of the verbenone had dissipated earlier than anticipated.

Project evaluation was conducted during the week of September 20. Though beetle flight was late, and less than anticipated, there were sufficient new attacks in all blocks to indicate little treatment effect, as shown in the following table:

*BLOCK**	*TREATMENT***	*1992 ATTACKS****	*1993 ATTACKS*
1	525	38	18
2	525	75	63
3	X	319	63
4	DOW	9	8
5	X	2	0
6	X	23	56
7	DOW	56	43
9	X	62	23
10	X	39	68
11	525	29	18
12	DOW	2	0

* An additional block (8) was selected, but logged prior to evaluation
** 525 and DOW are types of beads--application was same for both
*** Summary of four strip cruises per block (successful attacks)

We do not consider these results an indictment against verbenone. Rather, we believe further testing of beads and their elution rates is needed before additional testing of this promising protectant strategy.

REFERENCES

Gibson, K.E. 1994. Bark beetle pheromone use in the USDA Forest Service's Northern Region. *In* Symposium proceedings, Management of Western Bark Beetles with Pheromones: Recent Research and Developments. Pacific Branch Meeting of ESA, Kailua-Kona, Hawaii, June 1992. In press.

Gibson, K. and B. Oakes. 1993. Bark beetle conditions, Northern Region, 1992. USDA Forest Service, Northern Region, Forest Pest Management Report 93-3. 27 pp.

Kegley, S.J. 1994. Personal communication. Entomologist, USDA Forest Service, Northern Region, Forest Pest Management, Coeur d'Alene, ID.

McGregor, M.D., K.E. Gibson, and D.D. Bennett. 1979. Bark beetle conditions in the Northern Region, 1978. USDA Forest Service, Northern Region, Forest Pest Management Report 79-4. 13 pp.

McGregor, M.D., M.M. Furniss, R.D. Oakes, K.E. Gibson, and H.E. Meyer. 1984. MCH pheromone for preventing Douglas-fir beetle infestation in windthrown trees. J. Forestry, Vol. 82, No. 10, p. 613-616.

SCIENTIFIC NAMES

Beetles

Mountain pine beetle	*Dendroctonus ponderosae* Hopkins
Douglas-fir beetle	*Dendroctonus pseudotsugae* Hopkins
Pine engraver	*Ips pini* Say
Fir engraver	*Scolytus ventralis* LeConte
Western pine beetle	*Dendroctonus brevicomis* LeConte
Spruce beetle	*Dendroctonus rufipennis* (Kirby)
Western balsam bark beetle	*Dryocoetes confusus* Swaine
Red turpentine beetle	*Dendroctonus valens* LeConte

Hosts

Lodgepole pine	*Pinus contorta* var. *latifolia* Engelmann
Ponderosa pine	*Pinus ponderosa* Laws
Western white pine	*Pinus monticola* Douglas
Whitebark pine	*Pinus albicaulis* Engelmann
Limber pine	*Pinus flexilis* James
Douglas-fir	*Pseudotsuga menziesii* var. *glauca* (Beissn.) Franco
Grand fir	*Abies grandis* (Douglas) Lindl.
Subalpine fir	*Abies lasiocarpa* (Hook.) Nutt.
Engelmann spruce	*Picea engelmannii* Parry